LENS BARREL HAVING A FLARE DIAPHRAGM WHICH CAN ADVANCE INTO AND RETREAT FROM THE OPTICAL PATH TO ELIMINATE DELETERIOUS LIGHT RESULTING FROM MOVEMENT OF THE LENS

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to a lens barrel having means for removing deleterious light in an optical path of a photographic optical system.

2. Related Art Statement

Conventionally, the structure for removing light beams other than those reaching a film exposing plane in an optical path of a photographic optical system incorporated in a lens barrel has been widely known in the art.

For example, Laid-open Japanese Utility Model No. 63-160520 discloses a structure for moving a flare diaphragm forwards and rearwards along the direction of the optical axis with a zoom cam arranged in a zoom lens barrel.

Also, Laid-open Japanese Pat. Application No. 60-194414 discloses a structure which includes a flare diaphragm of a variable diameter so that the diameter of the flare diaphragm is changed on a plane perpendicular to the optical axis.

However, the structure disclosed in the above-mentioned Laid-open Japanese Utility Model No. 63-160520 has a problem in that deleterious light flux cannot be effectively cut since the flare diaphragm moves forwards and backwards along the optical axis.

The structure disclosed in the above-mentioned Laid-open Japanese Pat. Application No. 60-194414, in turn, has a problem in that the size of the entire lens barrel becomes larger because of a large space required to accommodate the flare diaphragm.

OBJECT AND SUMMARY OF THE INVENTION

It is an object of the present invention to provide a lens barrel having a simple structure which is capable of reliably cutting deleterious light flux.

A first lens barrel of the present invention has a flare diaphragm which is disposed on an optical path of lenses or in the vicinity thereof such that the flare diaphragm can advance into and retreat from the optical path for cutting deleterious light corresponding to the lenses moving in the direction of the optical axis.

A second lens barrel of the present invention comprises lenses forming a photographic optical system, a lens holding frame for holding the lenses, which is moved in the direction of the optical axis to perform a focal distance changing operation or a focusing operation for the photographic optical system, and a flare diaphragm advanced into and retreated from a photographic optical path for cutting deleterious light in response to movements of the lens holding frame in the direction of the optical axis.

Other features and advantages of the present invention will become fully apparent from the following description.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a cross-sectional view illustrating a lens barrel according to a first embodiment of the present invention which is in a wide-angle state;

FIG. **2** is an exploded plan view of a portion of the lens barrel illustrated in FIG. **1**;

FIG. **3** is a cross-sectional view illustrating the lens barrel shown in FIG. **1** which is in a telephoto state;

FIG. **4** is an exploded perspective view of a portion of the lens illustrated in FIG. **1**;

FIG. **5** is a cross-sectional view illustrating a lens barrel according to a second embodiment of the present invention which is in a wide-angle state;

FIG. **6** is a cross-sectional view illustrating the lens barrel shown in FIG. **5** which is in a telephoto state;

FIG. **7** is an exploded perspective view of a portion of the lens barrel illustrated in FIG. **5** which is in the wide-angle state;

FIG. **8** is an exploded perspective view of the portion of the lens barrel illustrated in FIG. **5** which is in the telephoto state;

FIG. **9** is a cross-sectional view illustrating a lens barrel according to a third embodiment of the present invention which is in a wide-angle state;

FIG. **10** is a cross-sectional view illustrating the lens barrel shown in FIG. **9** which is in a telephoto state;

FIG. **11** is an exploded perspective view of a portion of the lens barrel illustrated in FIG. **9** which is in the telephoto state;

FIG. **12** is a cross-sectional view illustrating a lens barrel according to a fourth embodiment of the present invention which is in a wide-angle state;

FIG. **13** is a cross-sectional view illustrating the lens barrel shown in FIG. **12** which is in a telephoto state;

FIG. **14** is an exploded perspective view of a portion of the lens barrel illustrated in FIG. **12**;

FIG. **15** is a cross-sectional view illustrating a lens barrel according to a fifth embodiment of the present invention which is in a wide-angle state;

FIG. **16** is a cross-sectional view illustrating the lens barrel shown in FIG. **15** which is in a telephoto state;

FIG. **17** is an exploded perspective view of a portion of the lens barrel illustrated in FIG. **15**; and

FIG. **18** is a cross-sectional view of a portion of the lens barrel illustrated in FIG. **15**.

FIG. **19** is a cross-sectional view of a portion of a lens barrel showing an example of the third modified embodiment in which the flare diaphragm is disposed on a lower side of a lens barrel.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

A lens barrel according to the present invention will hereinafter be described in connection with several preferred embodiments thereof with reference to the accompanying drawings.

FIGS. **1–4** are views illustrating a first embodiment of the lens barrel according to the present invention. FIG. **1** is a cross-sectional view illustrating the lens barrel according to the first embodiment of the present invention which is in a wide-angle state; FIG. **2** is an exploded plan view of a portion of the lens barrel; and FIG. **3** is a cross-sectional view of the lens barrel which is in a telephoto state. In addition, FIG. **4** is an exploded perspective view of a portion of the lens barrel.

A camera body, not shown, has a fixed frame **1** fastened thereto for serving as the basis for supporting of a photographic lens. A cam ring **2** is rotatably fitted on the outer periphery of the fixed frame **1** so as to be rotatable about an

optical axis O and inhibited from moving in the direction of the optical axis. The cam ring 2 is driven by a driving source, not shown, such as, for example, a motor or the like to rotate about the optical axis relative to the fixed frame 1. Inside the fixed frame 1, a first lens frame 3 and a second lens frame 4 are disposed for forward and rearward movements in the direction of the optical axis. The first lens frame 3 holds a first lens group L1, while the second lens frame 4 holds a second lens group L2.

Cam followers 3*a* are implanted in the outer periphery of the first lens frame 3. While only one cam follower 3*a* is illustrated in FIG. 1 for avoiding complicated illustration, there are actually three cam followers (typically equi-spaced) about the optical axis. Also, cam followers 4*a* are implanted in the outer periphery of the second lens frame 4, similar to the cam followers 3*a* in the first lens frame 3. These cam followers 3*a*, 4*a* are fitted in first cam grooves 2*a* and second cam grooves 2*b* formed through the cam ring 2, respectively, via an elongated groove 1*a* extending along the direction of the optical axis formed through the fixed frame 1. These first cam grooves 2*a* and second cam grooves 2*b* restrict the positions of the first lens frame 3 and the second lens frame 4 in the direction of the optical axis, i.e., the positions of the first lens group L1 and the second lens group L2 in the direction of the optical axis, and the cam followers 3*a*, 4*a* are inserted in the elongated groove 1*a* of the fixed frame 1 to restrict the rotation of the first lens frame 3 and the second lens frame 4 about the optical axis relative to the fixed frame 1.

At the back of the first lens frame 3, a supporting shaft 3*b* and a rotation stopper shaft 3*c* are implanted in parallel with the optical axis and extending in the rearward direction. The supporting shaft 3*b* is axially slidably fitted in a fitting hole 4*b* formed through the second lens frame 4. Also, as illustrated in FIG. 2, the rotation stopper shaft 3*c* is slidably fitted into a rotation stopper craw 4*c* radially disposed in the second lens frame 4. The rotation stopper craw 4*c* extends in the radial direction and is open at the outer peripheral end.

The supporting shaft 3*b* guides the second lens frame 4 to linearly advance relative to the first lens frame 3, while the rotation stopper shaft 3*c* prevents the centers of the first lens frame 3 and the second lens frame 4 from displacing, i.e., prevents the optical axes of the first lens group L1 and the second lens group L2 from mutually displacing in the direction perpendicular to the optical axis.

At the back of the second lens frame 4, a flare diaphragm 5 is rotatably supported by a shaft 6 implanted in the fixed frame 1. The flare diaphragm 5 is urged by a spring 7 (see FIG. 4) about the shaft 6 in the clockwise direction in the drawing. Also, the flare diaphragm 5 has a cam follower 5*a* which abuts on the outer periphery of the second lens frame 4 and a cam slope 4*d*. Further, the flare diaphragm 5 is formed at the lower end thereof with an arc-shaped diaphragm edge 5*b*.

A flange 1*b* is disposed at the rear end of the fixed frame 1, and at the inner end of the flange 1*b* on the optical axis side, a reduced diameter portion 1*c* extending rearwards is formed. This reduced diameter portion 1*c* has a function of preventing photographic light flux from entering into the camera body. Further, in the camera body, not shown, a film 8 on which the photographic light flux is focused is fed.

In a wide-angle state illustrated in FIG. 1, the first lens frame 3 and the second lens frame 4 are restricted their positions in the direction of the optical axis by the cam followers 3*a*, 4*a* and the first cam grooves 2*a* and the second cam grooves 2*b* of the cam ring 2, respectively.

In this wide-angle state, the cam follower 5*a* of the flare diaphragm 5 abuts on the outer periphery of the second lens frame 4. This causes the flare diaphragm 5 to be held in the state illustrated in FIG. 1 against the urging force of the spring 7. Since the diaphragm edge 5*b* is positioned away from a wide light beam 9 required to form a wide image, emitted from the rear end of the second lens group L2, the wide light beam 9 is focused at a predetermined point on the film 8 without any obstacle.

In this state, the cam ring 2 is rotated by a driving source, not shown, by a predetermined amount relative to the fixed frame 1. This causes the first cam grooves 2*a* and the second cam grooves 2*b* formed through the cam ring 2 to rotate relative to the elongated groove 1*a* formed through the fixed frame 1, so that the cam followers 3*a*, 4*a* respectively advance along the optical axis. Simultaneously, the first lens frame 3 and the second lens frame 4 advance integral with the first lens group L1 and the second lens group L2 along the optical axis to a telephoto position illustrated in FIG. 3.

In the telephoto state illustrated in FIG. 3, the first lens frame 3 and the second lens frame 4 are positioned further forward as compared with the wide-angle position. With the advance of the second lens frame 4, its cam surface 4*d* also advances. Since the flare diaphragm 5 is urged by the spring 7 in the clockwise direction, the cam follower 5*a* follows the cam surface 4*d* of the second lens frame 4 to rotate in the clockwise direction, and the diaphragm edge 5*b* of the flare diaphragm 5 projects toward the optical axis as illustrated in FIG. 3. A telephoto light beam 10 required to form a telephoto image, in the photographic optical system, passes near the lower end of the diaphragm edge 5*b* as illustrated in FIG. 3 and is focused at a predetermined point on the film 8 without any obstacle.

Here, a deleterious light beam causing a degraded image quality of photograph, when emitted from the rear surface of the second lens group L2, acts as a deleterious light beam 11 illustrated in FIG. 3 if the flare diaphragm 5 is not used, and the deleterious light beam reaches the film 8 after being reflected on the inner surface of the diameter reduced portion 1*c*. However, since the flare diaphragm 5 is in a posture having a larger angle than in the wide-angle state illustrated in FIG. 3, the deleterious light beam 11 is blocked its course by the diaphragm edge 5*b* and accordingly does not reach the film 8.

When the photographic optical system is changed from the wide-angle state to the telephoto state, the posture of the flare diaphragm 5 is determined by the cam surface 4*d* of the second lens frame 4. Stated another way, for passing a photographic light beam but blocking a deleterious light beam, the shape of the cam surface 4*d*, the shape of the flare diaphragm 5, and the shape and the position of the cam follower 5*a* may be appropriately changed to be applicable to different types of lens barrels. It goes without saying in this case that shapes and position optimal to a particular lens barrel should be employed.

In the zoom lens of the first embodiment structured as described above, even if the focal distance is changed due to a zooming operation, a photographic light beam required to form an image at each focal distance is passed while a deleterious light beam is reliably blocked, so that high quality photographs can be taken.

Next, a second embodiment of the lens barrel according to the present invention will be described with reference to FIGS. 5–8. FIG. 5 is a cross-sectional view illustrating the lens barrel according to the second embodiment which is in a wide-angle state; FIG. 6 is a cross-sectional view of the